



viledon®

## VILEDON FILTER SYSTEMS

THE COST-CUTTERS FOR GLITTERING RESULTS  
IN THE PAINT SPRAYING INDUSTRY

FREUDENBERG  
FILTRATION TECHNOLOGIES

 **FREUDENBERG**  
INNOVATING TOGETHER



## THE RIGHT FILTER CONCEPT FOR EVERY TYPE OF SYSTEM

Painting systems have to be supplied with large quantities of pure air, for reasons of cleanliness, operational reliability and hygiene. In order to prevent damage to the paintwork from airborne dirt, effective filtration of the intake and recirculated air is essential.

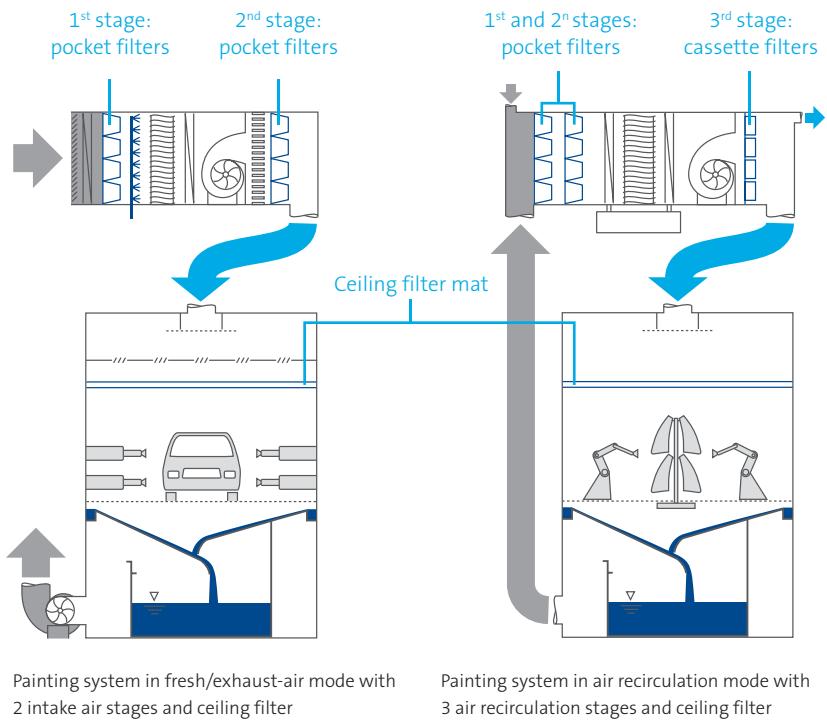
### Operating mode: fresh air/exhaust air

Traditionally operated systems for car body painting jobs are what are called fresh/exhaust-air systems. The fresh air is fed into the painting zones via air handling units, with a heat recovery feature where appropriate, while the exhaust air is discharged into the atmosphere without any further treatment via the wet-scrubbing unit in the floor. The average dust concentration of the ambient air is approximately 20–25 µg/m<sup>3</sup>, depending on the region, the weather conditions and the time of the year involved.

### Operating mode: air recirculation

More modern systems, particularly in the field of plastic component painting, are run in recirculated-air mode, in order to save on energy costs and to reduce VOC emissions (volatile organic compounds).

The major parts of the dust which need to be arrested in fresh/exhaust-air systems are (atmospheric) particles, fibers and dirt generated in the systems. In air recirculation systems the filter stages have to handle paint overspray particles and droplets not arrested in the water scrubber unit. The loading of the filter stages in the air recirculation systems is thus in most cases many times higher than with fresh-air systems. The aerosol concentration after the water scrubber systems is typically 2 to 3 mg /m<sup>3</sup>.



Painting system in fresh/exhaust-air mode with 2 intake air stages and ceiling filter

Painting system in air recirculation mode with 3 air recirculation stages and ceiling filter

### Sources of irritation

As a general principle, all airborne particles have to be arrested that would be capable of causing dirt-in-paint defects visible to the naked eye. In the field of surface treatment technology, we speak specifically of a critical particle size of  $>10 \mu\text{m}$ . In the case of painting systems operated in recirculating-air mode, things are rendered more difficult by the fact that continuous generation of fine overspray particles causes particles to accumulate in finer size ranges ( $<10$  and  $<5 \mu\text{m}$ ), whereupon agglomeration triggers problems like soiling and paint inclusions.

### Right on top

In both types of systems, by reason of their close proximity to the object being painted, ceiling filters with an active-adhesion finish are used. They are each tasked with two basic jobs: final filtration of the precleaned intake and recirculation air, i.e. reliable arrestance of dust particles measuring  $>10 \mu\text{m}$ , plus maximally even, turbulence-free air distribution inside the paint booth.

### Multi-stage design for enhanced reliability

The penetration of deleterious dust particles and fibers into the paint booths can be prevented only by a multi-stage intake and air recirculation filtration system. In the case of ordinary site conditions, fresh-air systems should feature 2-stage prefiltration, containing a prefilter and a fine-filter stage. For systems operating in recirculating-air mode, a 3-stage filter concept will usually be required in order to ensure cost-efficient operation, by reason of the high loading in the recirculated air.

In the high-temperature systems usually used for drying the paint, high-temperature filter cassettes of differing overall depth are used in a 2-stage configuration.

# VILEDON FILTERS

## A COMPLETE RANGE FOR MODERN-DAY PAINTING TECHNOLOGY

### Optimum filter combinations for cost-efficient painting operations

Selecting a cost-efficient filter combination is always an individualized solution, tailor-made to the locational factors, the quality of the ambient air and the dimensioning of the ventilation systems involved, as well as the customer's quality requirements. A combination comprising a pocket filter of Class G4 or M5 in the first stage (e.g. Compact F40 or F50) and a pocket filter or cassette filter of Class M6 or F7 (Compact T60 or MaxiPleat MX 85) in the second constitutes the optimum solution here.

In the case of painting systems featuring recirculating-air mode, the external conditions play a subordinate role, since the proportion of fresh air involved is usually very small. The crucial factors for cost-efficient operation of what are mostly 3-stage systems are here the paint storage capability and the fine-particle arrestance of the filter elements being used. A combination of 2 pocket filter stages (e.g. Compact F50 and T60) and a cassette filter (e.g. MaxiPleat MX 95) in the 3<sup>rd</sup> stage has proved its worth as a particularly efficient filtration solution. Besides cost-efficient operation, it also assures a high degree of process reliability.

### Ceiling filtration of superlative efficacy

In the final filtration stage, we recommend using Viledon® ceiling filters PA/560 G-10 (Class M 5) or PA-5 micron (Class M 6). Both filter mats are progressively structured, with a permanently adhesive finish of each individual fiber, and achieve the best possible class in the realistic Viledon® migration test (see page 8). The absolute dependability of the ceiling filter is a crucial precondition for reliable production in the painting process.

### Dependable when things hot up

In the high-temperature systems used for drying the paint, 2-stage filter systems are installed. In the air recirculation units, high-temperature filter cassettes with an overall depth of 292 mm are used in the 1<sup>st</sup> stage. As the 2<sup>nd</sup> stage, in the drying channels or chambers, what are called terminal flat cassettes are installed. In the field of plastic-component painting, synthetic filter products can sometimes also be used, thanks to the lower drying temperatures involved.

### What additionally counts

All Viledon® filter media are self-extinguishing in terms of fire behavior (DIN 53438, Class F1). The performance data for all fine filters of Classes M 5 to F 9 are regularly certified by Eurovent (see page 10).

RECOMMENDED VILEDON FILTER COMBINATIONS					
APPLICATION		STAGE 1	STAGE 2	STAGE 3	CEILING FILTER
Fresh-air systems	Paint line	F40 (G4) or F50 (M5)	T60 (M6) or MX85 (F7)		PA/560 G-10 (M 5)
	Paint drying	HT60 (M 6)	HT90 (F 8)* (overall depth 78 mm)		
Air recirculation systems	Paint line	F50 (M 5) or T60 (M 6)	T60 (M 6)	MX85 (F 7) or MX95 (F 8)	PA-5 micron (M 6)
	Paint drying	HT60 (M 6)	Ceiling filter** PA/560 G-10 (M 5) or HT90 (F 8)		

\* in practice, high-thermal-stability glass-fiber mats still frequently in use

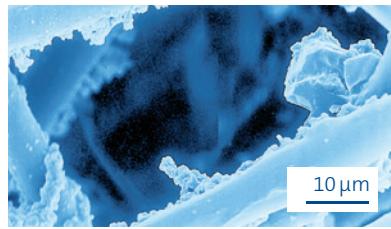
\*\* can be used briefly up to 120 °C

# DEPENDABLY IMPENETRABLE – THE PA RANGE

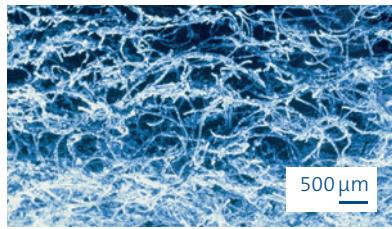
## HOLISTICALLY HEAT-PROOF – THE HIGH-TEMPERATURE FILTERS



Ceiling filter PA-5 micron



Dust deposits on adhesive-coated fibers (left) and progressive media structure (right)



### First choice worldwide

The technically sophisticated Viledon® ceiling filters of the PA range, PA/500-10, PA/560 G-10 and PA-5 micron, have for years been standard choices in the automotive industry, thanks to their reliability and cost-efficiency. These eco-compatible, disposal-friendly filter mats ensure practically 100-percent arrestance of particles >10 µm; this applies in the case of the PA-5 micron even for particles >5 µm.

### The “impenetrables”

The filter mats consist of synthetic-organic high-performance nonwovens, progressively structured so as to improve the dust storage capability and the collection efficiency. Their excellent adhesion performance is the result of effective fiber impregnation with optimally matched tackifying agents. Even temperatures of up to 100 °C do not impair this effect. The clean-air sides are specially smoothed. Dependable fiber bonding prevents any fibers

from becoming detached. The PA/560 G-10 and PA-5 micron types, moreover, are reinforced with a scrim on the clean-air side, which increases the stability of the filter mat and protects the clean-air side against possible damage during installation, thus making the actual handling significantly easier and speeding up the installation procedure.

### Standing the heat

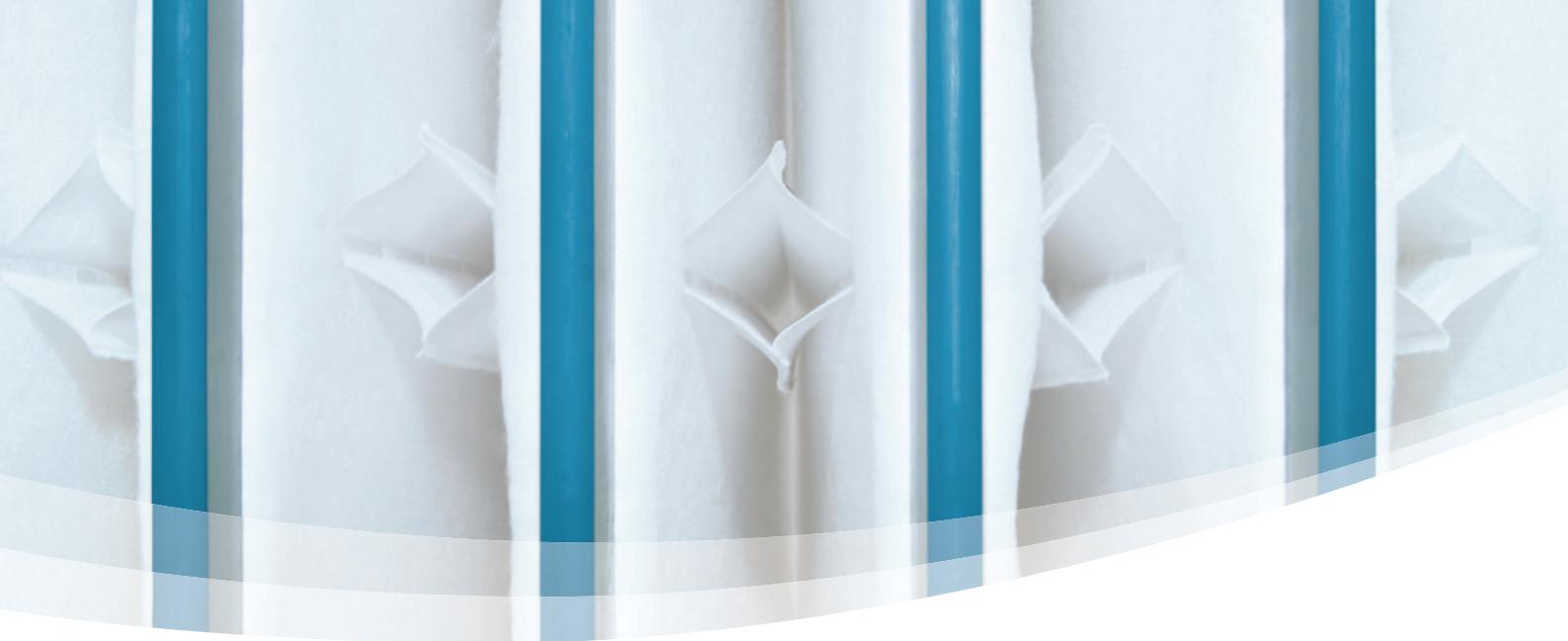
The Viledon® HT 60 and HT 90 high-temperature cassette filters are available in various models, with different dimensions, overall depths and frame materials, in Filter Classes M 6 and F 8. Their exceptionally high mechanical strength assures a high degree of operational dependability even under less-than-easy flow conditions in the drying systems. Depending on the version involved, the filters with micro-glassfiber nonwovens can be used at operating temperatures of up to 260 °C or 385 °C.



High-temperature filters HT 60 / HT 90 in overall depths of 292 mm



High-temperature filters HT 60 / HT 90 in overall depths of up to 78 mm



## HIGH-PERFORMING, ECONOMICAL, ENERGY-EFFICIENT

### COMPACT POCKET FILTERS AND MAXIPLEAT CASSETTE FILTERS

Thanks to their special design features, the Viledon® filter systems conceived for multi-stage intake and recirculation-air filtration excel in terms of high filtration performance coupled with exceptionally cost-efficient and dependable operating characteristics.

#### Tough when things get rough: Compact pocket filters

Dimensionally stable construction of the entire filter element ensures even dust storage with full utilization of the filtering surface, thanks to:

- Inherently stable filter pockets, welded in a leak-proof configuration, and foam-sealed into a PUR front frame, featuring aerodynamic spacers.

#### Sturdy and long-lived: MaxiPleat cassette filters

- Thermal embossing process with optimal V-shaped pleat geometry. Full utilization and even loading of the filtering surface, plus a homogenous flow pattern.
- High stability and torsional strength thanks to patented plastic frame construction.
- The one you rely on for arresting fine particles like paint droplets.



Compact pocket filter T60

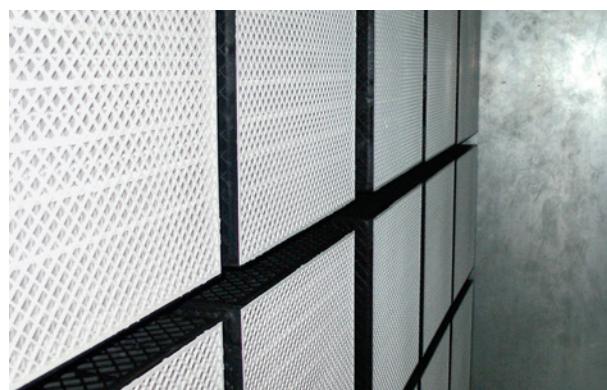


#### Pluses based on technical and performative excellence

- Long replacement intervals and high dust/paint storage capabilities thanks to special depth-loading filter media.
- Low pressure differentials and concomitantly reduced energy costs, thanks to an aerodynamically optimized design.
- They are classified as particularly energy-economical or energetically favorable under the Energy Efficiency Classes. Very substantial savings for the user in terms of all filter-related system costs.
- Their superlative operational dependability is rooted in the interaction between high-strength filter media, enhanced dimensional stability and mechanical sturdiness, coupled to ultra-meticulous, leak-proof workmanship of the filter elements assured by comprehensive quality control.
- Viledon® filters are corrosion-free, 100 % moisture-resistant, microbiologically inactive and fully incinerable.
- Top-quality accessories, like a support frame made of stainless steel or galvanized steel sheeting, with replaceable clamp spring systems and a rubber plug-in gasket.
- Viledon® filters meet all the requirements of the VDI 6022 Hygiene Guideline.



MaxiPleat cassette filter MX95



# FACTS, NOT PROMISES

## A MAXIMUM OF PROCESS DEPENDABILITY AND COST-EFFICIENCY

### The Viledon® migration test for ceiling filters

The most important criterion for ceiling filters in surface treatment technology is how far they can be relied upon to prevent dust breakthrough. This means: even under the most unfavorable of operating conditions, such as system-triggered vibrations, the dust particles once arrested must not become detached from the filter again. In the Viledon® migration test, the filter being tested is loaded with a defined test dust comprising non sticky aluminum oxide particles in a grain size range of 2–13 µm. The preset concentration is many times higher than "normal" conditions. In addition, the test rig enables vibrations of the cabin ceiling to be simulated. For assessing the filter, the clean-gas-side concentration of particles >10 µm is determined using a laser particle counter. The filters tested are assigned to Migration Test Classes S 0 to S 3.

The PA/500-10, PA/560 G-10 and PA-5 micron ceiling filters set the technical standard with Migration Test Class S 0. Field tests have shown that only ceiling filters of Migration Test Class S 0 provide the stipulated dependability over the entire operating period.

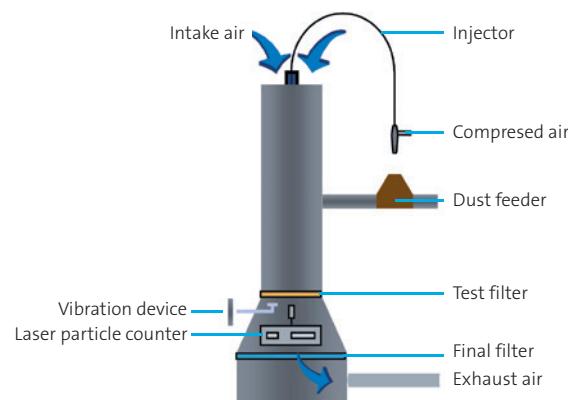
### Hygiene and operational dependability: requirements laid down in VDI 6022

Besides assuring air quality and dependability in the painting process, the air filter elements must also meet stringent technical hygiene requirements such as:

- The materials used must not constitute breeding grounds for micro-organisms.
- The filters must be easy to install without damaging them.
- During operation, no leaks must occur; the filters' collection efficiency must not deteriorate, etc.

Viledon® air filters meet all the criteria of the German VDI Guideline 6022 "Hygiene Requirements for HVAC systems".

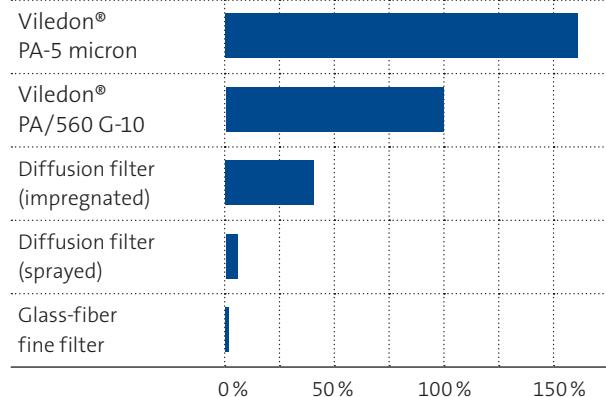
### Migration test rig



MIGRATION TEST CLASSES		
TYPE	VILEDON MIGRATION TEST	PARTICLES >10 µm/m³
Viledon® PA/500-10	S 0	< 10
Viledon® PA/560 G-10	S 0	< 10
Viledon® PA-5 micron		
Diffusion filter (impregnated)	S 1	< 100
Diffusion filter (sprayed)	S 2	< 1000
Synthetic fine filter mat	S 3	< 1000
Glass-fiber fine filter	S 3	< 1000

## Long-term stability of the adhesive finish

Relative dust bonding capacity  
(face velocity: 0.5 m/s, test aerosol:  
coarse aloxite)



### Adhesion activity in the long-time test

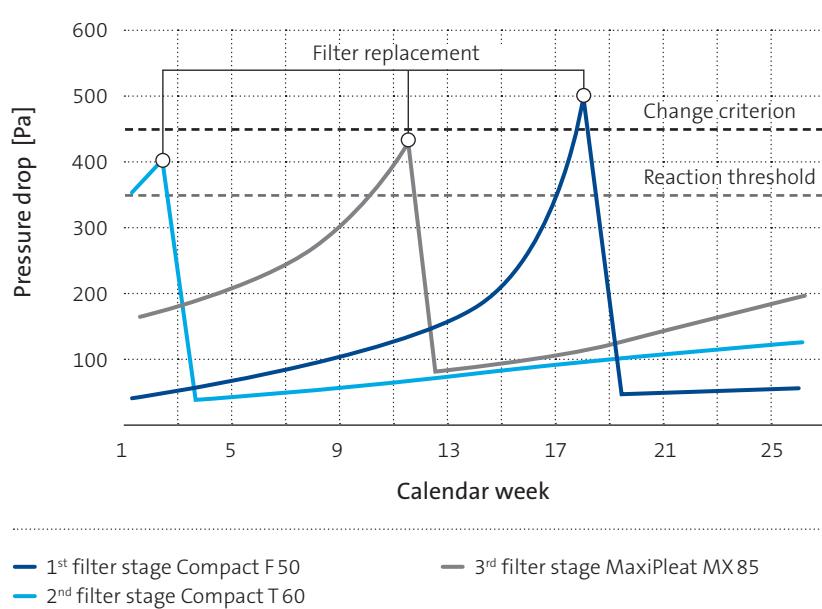
To simulate its long-term behavior, the ceiling filter is loaded with pourable, non sticky coarse dust until the dust bonding capacity no longer suffices to maintain the original Migration Test Class or the collection efficiency falls. The test result is a direct measure for the resistance to dust penetration after a long period of service (see diagram).

### Maximized paint storage capacity for long replacement intervals

In order to assure maximally cost-efficient operation of ventilation systems, crucial considerations include not only the initial pressure drop but also the filters' storage capabilities. In the case of air recirculation systems, particularly, in the field of plastic component painting, the filters are often loaded with very high concentrations of paint particles.

Viledon® Compact pocket filters are second to none in terms of initial pressure drop, paint storage capacity and process dependability. The combination of progressively structured, synthetic-organic filter material with the welded-in spacers and the foam-sealed front frame creates an exceptionally sturdy filter construction. An indispensable precondition for reliable, cost-efficient and long-lasting operation of the filters in air recirculation systems.

### Typical pressure drop curve of the filters in a 3-stage paintshop air recirculation system





### Energy Efficiency Classes make your choice easier

The resistances of the air filters make a crucial contribution towards the electricity consumption of ventilation systems. Besides a low initial pressure drop, it's also important to have as flat as possible a pressure drop development over the operating period involved. (see diagram, page 9). To simplify comparisons between different air filters in terms of energy efficiency, the European energy efficiency classification system EUROVENT 4/11 was developed.

The classification covers not only the Filter Class and the initial pressure drop, but also the mean pressure drop over a defined period of duty. Operation of ventilation systems can thus be easily optimized in terms of energy economy by carefully selecting filters from the Energy Efficiency Classes A to C.



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Freudenberg Filtration Technologies  
Weinheim/Germany

THE ENERGY-EFFICIENT VILEDON COMPACT POCKET FILTERS AND MAXIPLEAT CASSETTE FILTERS

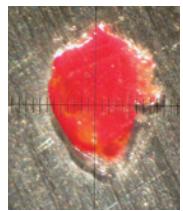
FILTER TYPE	FILTER CLASS	ENERGY EFFICIENCY CLASS*
Pocket filter	G 35 SL	G 3
	F 40	A
	F 50	A
	T 60	A
	T 90	A
Cassette filter	MF 90	C
	MX 75	—
	MX 85	B
	MX 95	A
	MX 98	A

\* According to Eurovent 4/11, rated at 3,400 m<sup>3</sup>/h

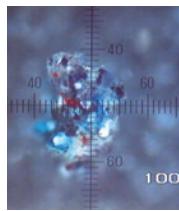
### You can safely trust us, because we are independantly monitored

A certification program set up by Eurovent (the European confederation of manufacturers for ventilation, indoor climate control and refrigeration systems) assures compliance with the published technical data of fine filters by means of independent monitoring. Manufacturers participating have to be certified under the ISO 9001 quality

standard. Freudenberg was one of the first filter manufacturers to receive this certification. The filter data published, like pressure drop and the efficiency of the fine filters in Classes M5 to F9, are checked at regular intervals. If you look for certified quality, you can be sure you're getting what you're paying for.



Dirt-in-paint defects under the light-optical microscope



Computer-aided flow analyses CFD

## VILEDON FILTERCAIR

### THE FILTER MANAGEMENT SYSTEM FOR OPTIMIZING PAINTING PROCESSES

#### A holistic spectrum of services

Viledon® filterCair is a service program put together in a specific response to customers' expressed wishes, comprising top-quality filter products from the Viledon® brand range, plus service support and warranty back-up. Within the framework of maintenance agreements, experienced Site Technicians provide process-integrated services, such as:

- Monitoring relevant process parameters in operation.
- Planning and warehousing of the filters, organizing and carrying out filter replacement routines, including disposal of the filters and cleaning the systems, and much more.

The principal benefits of Viledon® filterCair for the user inhere in optimization of the painting process in terms of the defect and rejection rates, in increased system availability, and reduced operating costs. An offer that many top-ranking European automakers and their component suppliers are already utilizing.

Due to the large number of possible contamination sources that may cause dirt-in-paint defects or necessitate reworking, under the filterCair concept a holistic approach is adopted for the production process.

To ensure significant improvements in your painting process, highly trained Site Technicians provide the following services, for example:

- Particle measurements using laser particle counters, either stationary or as ProSim measurements.
- Detection of down draught distribution, booth balancing, ventilation balance, temperature and relative humidity.
- Paint inclusion and dirt analyses on site or in the Viledon® laboratories (SEM, EDX, IR microscopy).
- Hygiene inspections for ventilation systems in conformity with VDI 6022.
- Computer-aided flow analyses (CFD – computational fluid dynamics) prior to modifications, new concepts or re-adjustments.
- Visualizing of air flows using fog generators.
- Measuring electrostatic charging and discharging processes.
- Assessments of the materials used in the painting process in regard to releasing particles and fibers.
- And much, much more.

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